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## (54) Prestressing of concrete articles or structures

(57) A prestressing anchor (1) includes a body portion adapted to be rigidly located in concrete or like material and has two generally longitudinally opposed ends and two generally transversely opposed sides. A plurality of openings (2-5) including both an outlet means (3, 5) and an inlet means (2, 4) are at each of the ends arranged in two diagonally opposed co-operative pairs of inlet and outlet means. Each respective co-operative pair of inlet and outlet means provides through access for respective prestressing tendons (30) so that they may be tensioned at a point intermediate their dead anchors. Two structures may be interconnected by arranging the anchor at the junction, so that one structure and its tendon may be completed, and then the second structure completed. When the tendons are in place and tensioned, the whole assembly is embedded in concrete, and to this end, grout inlet (16) is provided. The tendons cross each other in an interleaved array within the anchor.

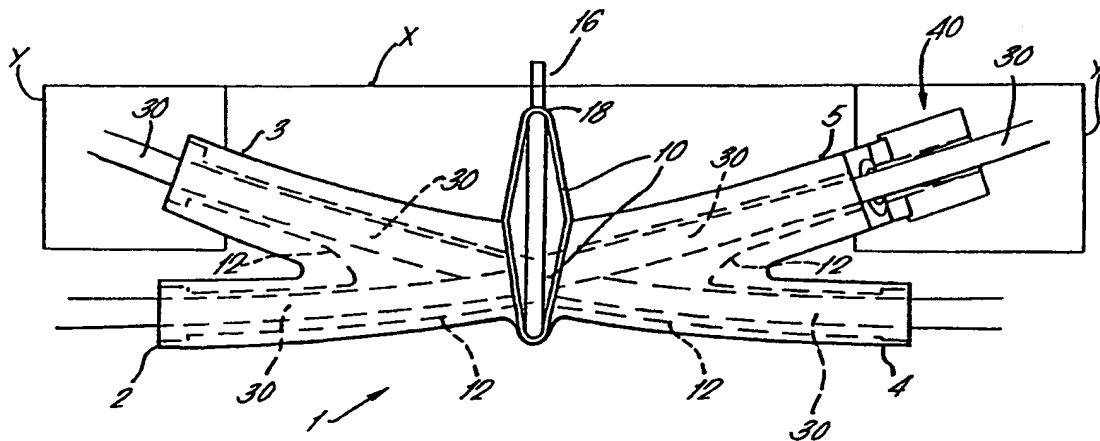
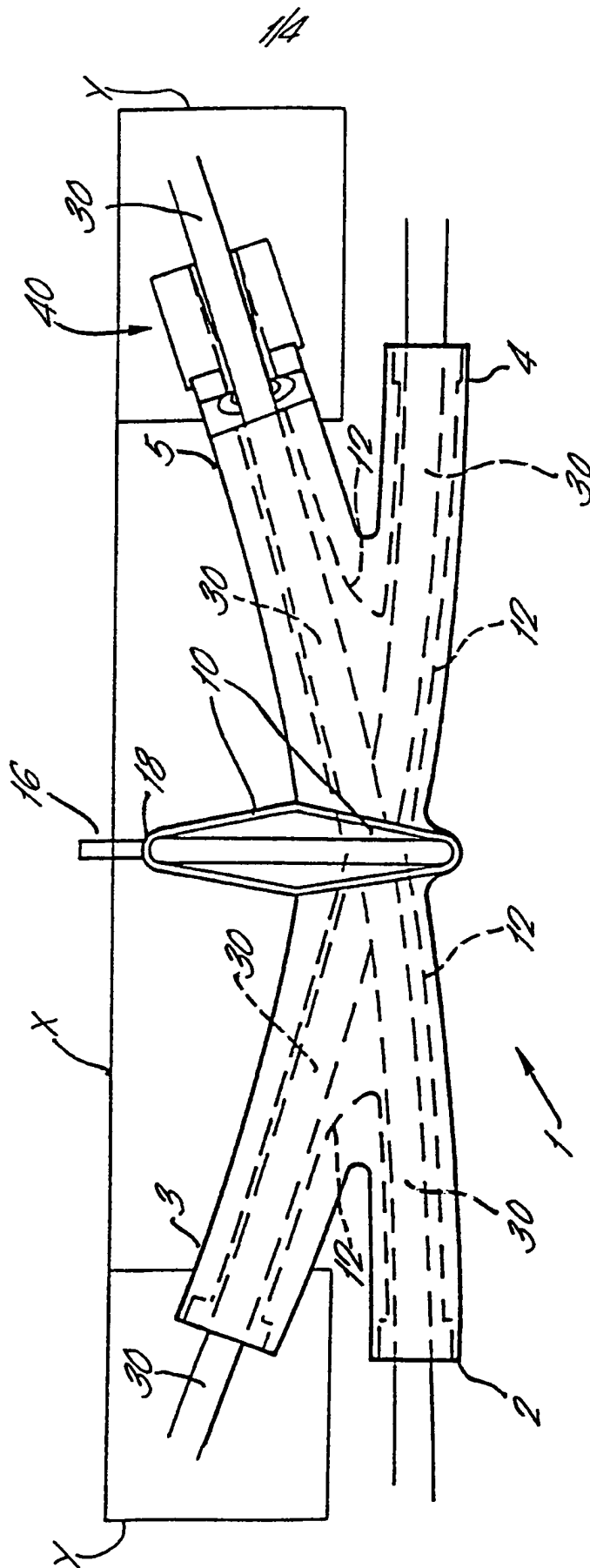


FIGURE 1

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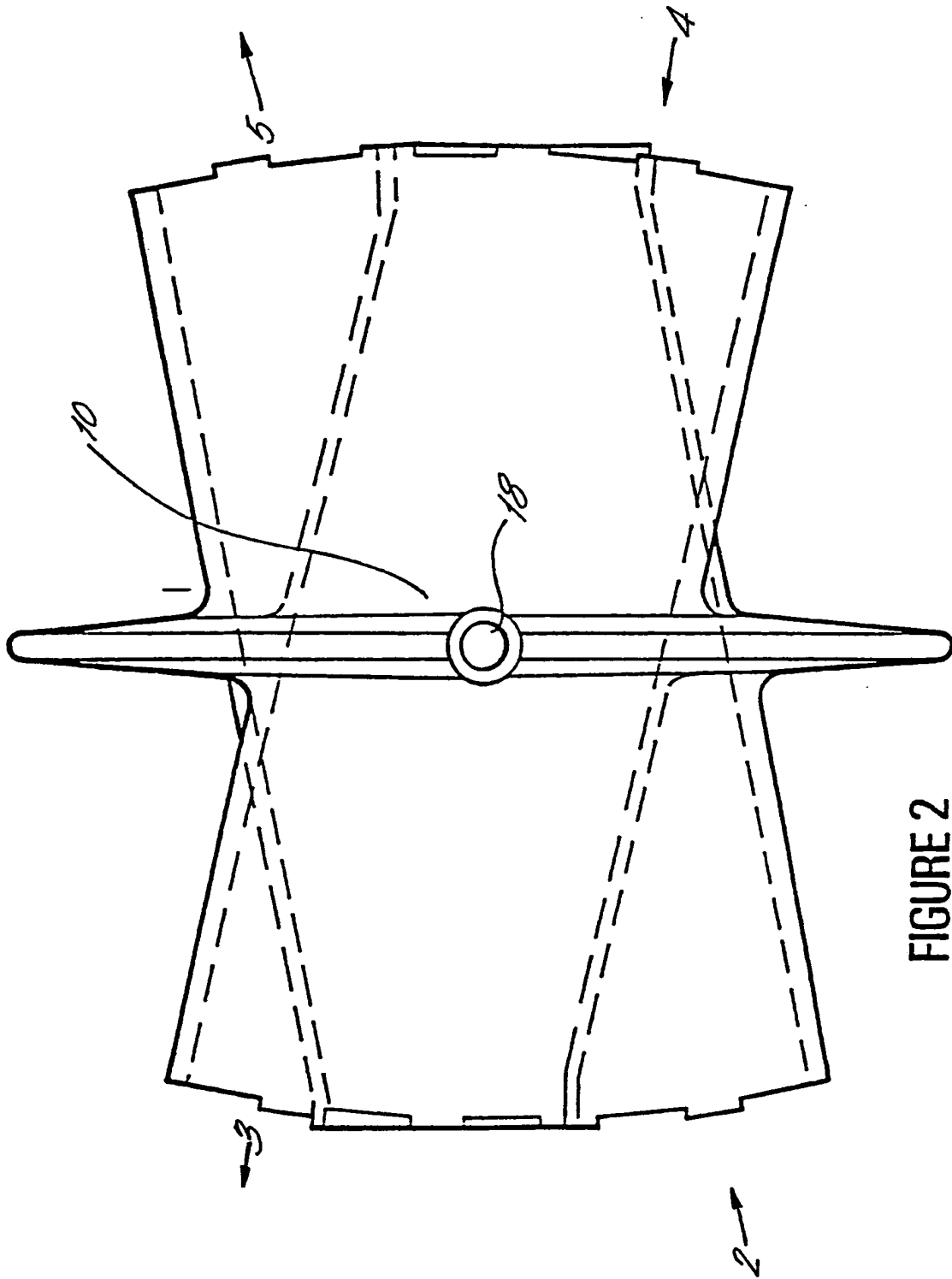


FIGURE 2

3/4

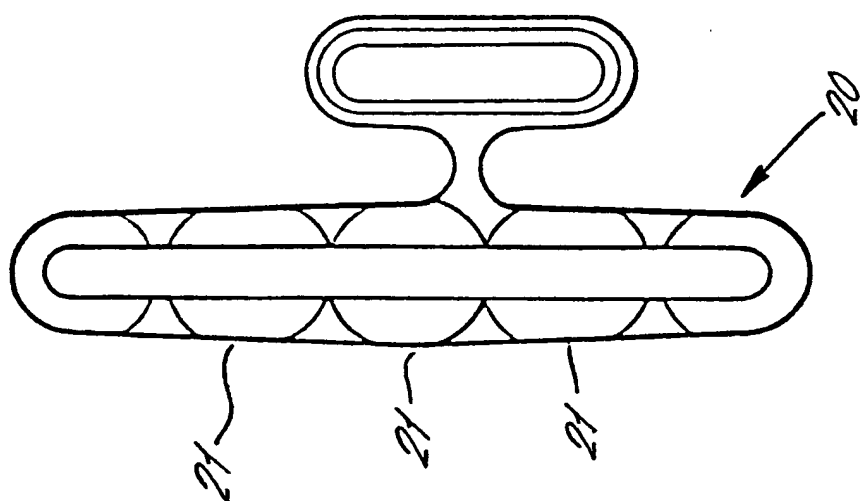


FIGURE 3

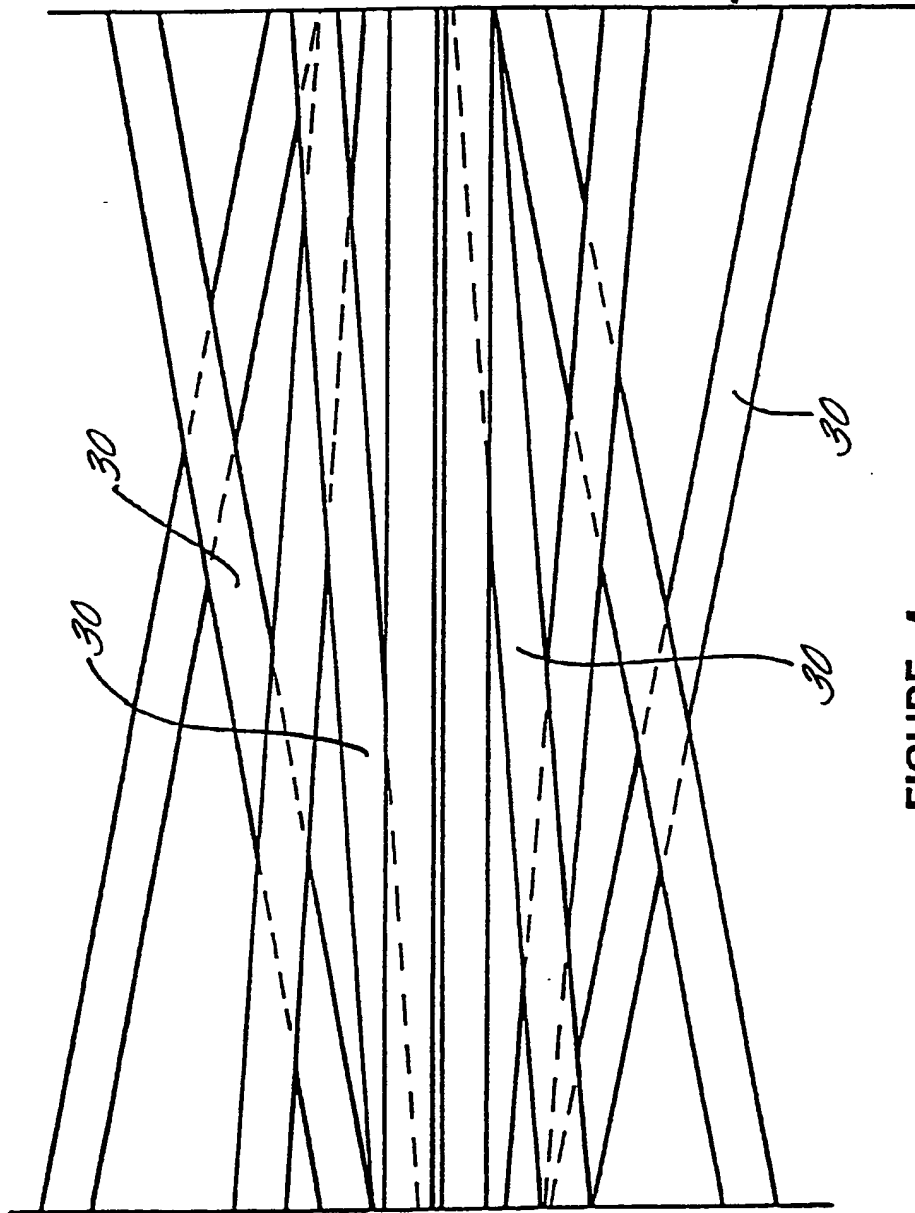


FIGURE 4

IMPROVEMENTS IN AND RELATING TO THE  
PRESTRESSING OF CONCRETE ARTICLES OR STRUCTURES

THIS INVENTION relates to the prestressing of concrete articles or structures.

It is well known to prestress articles or structures, so as to strengthen such articles or structures. The present invention relates in particular to an anchor  
5 arrangement for use in such prestressing and to a method of prestressing using such anchor means.

Up until this time, in the prestressing of concrete articles or structures, it has often been difficult to  
10 effectively apply prestressing tension to tendons, due to the positioning of the article or structure. For example, when it is desired to prestress beams or floors in a building, it is often very difficult to apply prestressing tension at the ends of those beams or floors, because of  
15 the juxtaposition of adjacent buildings. Further, because of the height of some buildings or structures, it is often difficult to get access to the ends or sides of, for example, floor slabs, to allow for effective prestressing. In many cases it is necessary to attempt to  
20 apply the prestressing pressure from a position towards the middle of the beam or floor and at present this brings about many practical difficulties. In some cases it is necessary to attempt to apply the prestressing pressure from below the formed beams or floors which is  
25 particularly difficult and dangerous from an operative point of view. It is often necessary to prestress tendons extending from each end of a beam or floor separately, and this is time-consuming, expensive and involves difficulties.

30 The present invention sets out to provide a straightforward and efficient alternative in the prestressing of concrete articles or structures wherein the prestressing can be effected at a position substantially intermediate ends of the beam or structure,  
35 the present invention utilising an anchor which is so

formed as to allow tendons from each end of an article or structure to be passed through the anchor from opposing ends and to exit therefrom on substantially the same side. Thereafter, and following the pouring and at least  
5 partial curing of concrete, ends of the tendons will extend out of the anchor as embedded within the concrete, thus allowing prestressing tension to be applied to said tendons as they extend out of the anchor at a position substantially intermediate the ends of the article or  
10 structure. The present invention therefore provides a prestressing anchor and a method of prestressing concrete articles or structures, which goes at least some way towards overcoming and at least minimizing the problems encountered up until this time.

15 It is an object of this invention to provide a prestressing anchor for use in prestressing concrete articles and structures, and a method of prestressing which is efficient and straightforward.

Other objects of this invention will become apparent  
20 from the following description.

In one broad form the present invention can be said to provide a prestressing anchor comprising:

a body portion adapted to be rigidly located in concrete or like material and having two generally  
25 longitudinally opposed ends and two generally transversely opposed sides; and

a plurality of openings including both an outlet means and an inlet means at each of the ends arranged in two diagonally opposed co-operative pairs of inlet and  
30 outlet means, and each respective co-operative pair providing through access for respective prestressing tendons.

According to another aspect of this invention there is provided an anchor for use in prestressing concrete  
35 articles or structures, substantially intermediate

opposing ends thereof, and wherein one or more elongate tendon extends inwardly from ends of said article or structure to positions substantially intermediate said ends; said anchor including a body portion locatable  
5 substantially intermediate said ends of said article or structure, and comprising inlet and outlet means at opposing ends, respective inlet and outlet means at opposing ends being substantially diagonally opposed one to the other, the arrangement being such that one or more  
10 tendons from opposing ends of said article or structure are able to pass into said anchor substantially intermediate the ends of said article or structure, through inlet means and thereafter through said body portion to pass out of said anchor through said diagonally  
15 opposed outlet means; said inlet and outlet means being so formed and positioned in said anchor that one or more tendons extend outwardly of said outlet means on substantially the same side of said anchor while diverging away from each other in substantially opposite directions,  
20 such as to allow said one or more tendons to be stressed.

According to a further aspect of this invention, there is provided a method of anchoring and maintaining prestressing tendons in position for prestressing a concrete structure, comprising extending one or more  
25 elongate tendons from an end of said structure to an anchor located or positioned distal said end of said structure, said anchor comprising a body portion formed with both inlet and outlet means at opposing ends thereof; said inlet means on opposing ends being on  
30 substantially the same side of said anchor and each inlet means communicating with a substantially diagonally opposing outlet means; said outlet means each being on the same general side of said anchor; and passing said one or more tendons from said end of said structure  
35 through inlet means at a first end of said anchor;



through said body portion and out through substantially diagonally opposed outlet means; and thereafter pouring concrete about said tendons and anchor but with said outlet means and ends of said tendons extending therefrom  
5 remaining exposed, such as to allow said tendons to be stressed.

The method may additionally include extending tendons from a second end of the structure to the anchor being positioned intermediate said ends of the structure,  
10 passing one or more tendons from a second end of said article or structure through inlet means at a second end of said anchor and through said body portion so that the tendons pass through and about the tendons passing through said body portion from the first end of the article or  
15 structure; and thereafter pass out through a diagonally opposed outlet, such that said tendons intermesh within the body portion of said anchor.

This invention will now be described by way of example only, with reference to the accompanying drawings,  
20 wherein:

Fig. 1 is an elevational view of a prestressing anchor according to one form of the present invention,

Fig. 2 is a plan view of a prestressing anchor according to one form of the present invention,

25 Fig. 3 is a sectional view of an inlet end of an anchor according to one form of the present invention,

Fig. 4 is a plan and diagrammatic view of tendons passing through an anchor according to one form of the present invention.

30 Referring to Figs. 1, 2 and 3 of the accompanying drawings, the anchor 1 is formed as a general body portion, having an inlet 2 and outlet 3 at one first end thereof, and an inlet 4 and outlet 5 at a second end thereof. In the form of the invention shown in the  
35 accompanying drawings, the respective inlets 2, 4 are on

the same lower side of the anchor while the outlets 3, 5 are on the generally same upper side of the anchor.

Each end of the anchor 1 is formed as substantially bifurcated arms, the inlets 2, 4 leading into a main inner chamber portion 10 and thereafter being substantially aligned with a diagonally opposed outlet 3, 5. The inner surfaces 12 of the inlets 2, 4, outlets 3, 5 and chamber 10 are generally profiled and partially radiused so as to provide a smooth transition from the inlet 2, 4 to the generally diagonally opposed respective outlets 3, 5. Thus, in use, as tendons 30 are fed in through an inlet 2, 4, the profile and generally radiused nature of the inner surfaces or walls 12 of the anchor 1 will assist in directing the tendons from one inlet 2, 4 to a diagonally opposed outlet 3, 5 free of any sharp structures which would cause stress concentrations in the tendons.

Each inlet 2, 4 is preferably provided with inlet guide means 20 (see Fig. 3), attached thereto or integrally formed therewith. The inlet guide means 20 consist of a plurality of juxtaposed but spaced apart profiled guides 21, each guide 21 being adapted to house and locate a tendon 30 so that the tendons can be fed through the inlet guides 21 and thereafter through the outlets 3, 5 in a substantially regular and spaced apart manner, thus allowing the tendons to be positioned substantially side by side and spaced apart, so that when the tendons are inserted from an inlet at the other end of the anchor, the tendons can be inserted about and between the tendons from the first end in an interweaved manner, thus allowing tendons to pass from both inlets 2, 4 at opposing ends of the anchor, to cross past but not interface in the chamber position 10 of the anchor and to thereafter pass into, and exit from substantially diagonally opposed respective outlets 3, 5.

Referring to Fig. 4 of the accompanying drawings, this shows by way of example, the interweaving of the tendons 30 as they pass through the anchor, tendons passing from both first and second ends of the anchor.

5 The intermeshing therefore takes place within the body portion, and in one form within the chamber portion 10, as respective tendons pass from respective inlets to respective outlets.

The anchor of the present invention and the provision  
10 of the inlet guide means 20 allows the tendons 30 not only to intermesh within the anchor as they pass from respective inlet to respective outlet, but separates the tendons so that they can extend outwardly from the outlets substantially spaced from one another, so that the tendons  
15 are able to be stressed separately one from the other. To allow such stressing to take place, appropriate prestressing grip means (grips), such as for example barrel means and wedges 40 are applied to the ends of the outlets 3, 5 so that the ends of the tendons 30 extend  
20 therethrough to be thereafter stressed by means of appropriate stressing mechanisms or appliances, such as prestressing jacks and the like.

Referring to Figs. 1 and 2 of the accompanying drawings, it will be seen that the upper (or lower)  
25 portion of the main body portion 15 of the anchor 1 is provided with a grout or mortar inlet port 18, so that following the predetermined or desired prestressing, grout or mortar (or some other filler) can be inserted into the anchor to bind within the body portion of the anchor and  
30 about the tendons to thus positively locate and seal the tendons within the anchor.

It will be appreciated from the foregoing description that in use and following location of the tendons 30 within the anchor 1 (but prior to prestressing  
35 thereof), concrete is poured over the anchor or over part

of the anchor, and the anchor always remains in situ within the structure resulting. It should be appreciated that during such initial pouring form work is extended about the outlets 3, 5 so that concrete is not poured over  
5 or into the outlets and so that there is an appropriate step or recess in the resultant article whereby a jack or appropriate prestressing implement can be readily connected to the tendons, for the purpose of prestressing same. Following the predetermined or desired prestressing  
10 to the required limit, such recesses or indents are filled in so as to complete the desired surface of the structure.

Referring in particular to Fig. 1 of the accompanying drawings, such an arrangement is shown by way of example, where the surface X is the desired surface of the finished  
15 article or structure, form work Y being shown, as to where it may be positioned during the concrete being poured so as to maintain the outlets 3, 5 and ends of the tendons free, but to otherwise cover and locate in situ the anchor. In order to avoid the grout or mortar inlet port  
20 18 being covered, an appropriate tube or the like 16 can extend upwardly from that portion of the anchor so that the concrete will form thereabout, to allow for a channel through which the mortar or grout (or other filler) can be inserted. Following use, this can be filled and covered  
25 over, as can and are the steps or recesses surrounding the outlets.

It has been found in experimentation that the present invention is particularly advantageous in providing a method and means whereby tendons can be inserted from  
30 opposing ends or sides of a structure or article to be formed and also whereby prestressing can take place from one direction and thereafter from another direction by utilising the same anchor. The intermeshing of the tendons, having been fed into the anchor from one side and  
35 then from another side, allows for transmission of

prestressing forces in an effective and straightforward manner. The intermeshing of the tendons within the anchor has been found to cause the tension forces to be transmitted through the body of the anchor and between  
5 respective tendons. The present invention also allows for the anchor to be embedded and located within the structure so as to result in a positive prestressing anchor. The anchor also allows for prestressing to take place in a straightforward and efficient manner at a position  
10 substantially intermediate ends of the article or structure, thus overcoming or at least reducing the problems which have been encountered in the prestressing industry up until this time.

In the exemplary embodiment of the invention now  
15 described the anchor is formed of a cast metal but can be of other appropriate material.

The anchor preferably has a main body portion, having flanges extending outwardly therefrom, which flanges allow for stresses to be dissipated into and distributed through  
20 surrounding concrete. If desired, the anchor can take the form of a general block of material having the features to be described hereinafter.

The anchor can be located and positioned substantially intermediate ends of a structural article to  
25 be formed of concrete, and during the formation of form work, to allow for the subsequent pouring of the concrete. The anchor can be positioned on appropriate cradles or supports so that ends thereof extend towards substantially opposing ends of the structure or article to  
30 be formed. In preparing for the pouring of the concrete and subsequent prestressing thereof, appropriate tendons are secured at spaced apart positions in the form work of the article or structure to be complete and preferably extend, through appropriate ducting and the like, from a  
35 position substantially adjacent each end of the article or

structure to be formed to a position substantially intermediate the ends thereof. While I refer to ducting, by way of example, the invention is not of course limited to use with ducting and has equal application to debonded  
5 cables and tendons.

The anchor is formed with pairs of diagonally opposed inlet and outlet means at the ends of the anchor, so that tendons extending from a first end of a structure or article may pass through the inlet of a first end of the  
10 anchor while tendons extending from a second end of the article or structure to be formed extend towards and through an inlet in the second end of the anchor. Each end of the anchor is provided with an outlet means, the outlet on the first end of the anchor being substantially  
15 diagonally opposed to the inlet on the second end of the anchor and the outlet on the second end of the anchor being substantially diagonally opposed to the inlet on the first end of the anchor. In use, the tendons are fed through the inlet in one end (for example the first end),  
20 through an inner body portion of the anchor and into the outlet portion of the second end of the anchor so that the ends of the tendons extend therefrom. Following this, the tendons from the second end of the structure or article to be formed are fed through the inlet in the second end of  
25 the anchor and through and about (so as to substantially intermesh with) the tendons from the first end as already extending or passing through the body portion of the anchor. On the tendons from the second end of the structure to be formed having passed through the inlet and  
30 through and about the first end tendons, the second end tendons are then passed into and through the diagonally opposed outlet on the first end of the anchor.

Preferably, the outlets are on the same general side of the anchor and the inlets are on substantially the same  
35 side of the anchor, said respective sides being

substantially opposed one to the other.

In one form of the invention the inlets are preferably formed in or adjacent a lower or base side of the anchor while the outlets are provided adjacent a generally upper or top side of the anchor. This then allows for the tendons extending from the anchor to be tensioned from an upper surface of the article or structure to be formed (as will be described hereinafter). However, if desired, the inlets may be provided in the generally upper side of the anchor while the outlets are provided in the generally lower side of the anchor, where for example it is desired to apply stressing tension to the tendons from below the surface or structure to be formed. In yet a further form of the invention, the inlets and outlets can be provided on generally opposed vertical sides of a structure, such as when a generally upright or substantially vertical structure is being formed. These positions are therefore by way of example only.

Throughout the specification and claims reference may be made to the article or structure to be formed. it should be appreciated therefore that this relates to and defines a structural article to be formed (such as for example a beam or building floor, or tank), prior to the pouring of the concrete, but while appropriate form work and the like is in place to allow for the subsequent formation of the article or structure.

It should be appreciated that the present invention has application to all forms of prestressing operations, including both pre-tensioning and post-tensioning methods.

In the preferred forms of the present invention, once the tendons have passed through the anchor and ends thereof are extending outwardly from the outlets, appropriate form work can be placed about the anchor and outlets so that when concrete is poured within the general

form work, to form the desired article or structure, recesses or indents will be formed about and around the outlets of the anchor and extending tendons, so that once the concrete is poured, the anchor per se will be retained  
5 in situ within the formed concrete work, but with appropriate recesses formed about the outlets so that appropriate apparatus, implements and the like, such as jacks, can be applied to the tendons to prestress same. Such recesses or indents are able to be plastered o  
10 concreted in following the prestressing. The main body portion of the anchor is provided with an inlet port, leading into the body portion of anchor so that following prestressing appropriate grout, binder and the like can be inserted into the anchor to bind about the tendons in the  
15 normal manner.

It should be appreciated however that in the described form the anchor following pouring of the concrete, is located in situ within the formed structure or article.

20 The described anchor and the method of using the anchor and feeding tendons therethrough allows the tendons to extend from spaced apart positions along the length of an article or structure to be formed (and following formation from ends of the article or structure so formed)  
25 and to a substantially unitary anchor where the tendons are able to be stressed in a straightforward and efficient manner. Preferably, the anchor is positioned so that the outlets are at the upper side of the anchor and so that the tendons extend outwardly from an upper side of the  
30 article or structure to be formed (and following pouring from an upper side of the structure so formed). This therefore allows prestressing to take place from an upper surface of the article or structure, by using known prestressing means such as jacks and the like in a  
35 straightforward and efficient manner.



In the preferred form of the invention, the inlet means are provided with or formed as a plurality of adjacent and substantially side by side but spaced apart inlet guides through which the tendons are passed so that  
5 the tendons are located separately one from the other and marginally spaced apart, as they pass through the inlets and out through the diagonally opposed outlets. This then marginally spaces the tendons one from the other, laterally, so that tendons inserted from the inlet at the  
10 other end of the anchor which is also provided with such inlet guides, may pass between and about the tendons from the first end so that the tendons intermesh one with the other as they pass through the anchor and from respective inlets to respective outlets. In the preferred form of  
15 the invention the tendons are fed in to the anchor from one end and out through the outlet, and are thereafter inserted from the other end, through and about the tendons already located within the anchor and out through the respective outlet at the other end. The internal geometry  
20 is such that a plurality of tensioned opposing tendons passing through the anchor apply at most small side loads to adjacent tendons so as to prevent significant stress concentrations in the tendons.

The inlet guide means therefore allow the tendons to  
25 be positioned marginally spaced apart one from the other in a position to allow for this intermeshing of tendons when the tendons are inserted into the anchor from opposing ends. The inlet guides also allow for the efficient "feeding in" of the tendons.

30 The present invention is able to be used for the prestressing of unitary or single articles or structures, and can also be used where it is desired to prestress one section or article or structure (for example towards or at one end of the anchor) and to thereafter at some later  
35 stage or date prestress a section or article or structure

at the other end of the anchor. Thus the present anchor can be used for coupling the prestressed sections together and for the prestressing of both sections by one or more tendons from one section passing into the anchor from one end (adjacent the section being formed) and being held in position and partially bound by that section, the one or more tendons then being prestressed such as by appropriate appliances, such as jacks, following at least partial curing of the concrete at that first end. Thereafter, one or more tendons from a second structure can be inserted through the second end, to intermesh about and between the one or more tendons already stressed within the anchor, the second section then being poured and partially cured, whereafter the second tendons are stressed. As indicated hereinbefore, appropriate form work and the like is formed about the areas of the anchor ( that are not to be covered with concrete during the initial pour) so as to allow for the stressing and insertion and stressing of further tendons. The time delay between the insertion and stressing of first tendons from one end of the anchor and the insertion and stressing of tendons from the second or other end of the anchor depends upon constructural restraints, weather, pouring times and the like. It is however to be appreciated that in the resultant article or structure to be formed, the anchor will be embedded within the formed structure or article. It will be appreciated that one or more tendons from a first end may be installed before and/or after, and/or substantially simultaneously with, one or more tendons from a second end.

It is sometimes desired to erect a building and later, perhaps after some years, to erect an adjoining building coupled to the first as a single structure. In such circumstances the anchor can be positioned at the end of the first building to which the second is planned to be later coupled, normal tensioning effected, the anchor left

hollow without grout and the tendons grouted fast. When the second building is erected its prestressing tendons will be passed through the anchor and tensioned before filling the anchor with grout.

CLAIMS

1. A prestressing anchor comprising:  
a body portion adapted to be rigidly located in concrete or like material and having two generally longitudinally opposed ends and two generally transversely opposed sides; and  
a plurality of openings including both an outlet means and an inlet means at each of the ends arranged in two diagonally opposed co-operative pairs on inlet and outlet means, and each respective co-operative pair providing through access for respective prestressing tendons.
2. A prestressing anchor as defined in claim 1 wherein each inlet means defines an opening direction approximately longitudinal of the body portion and the outlet means define opening directions being mutually divergent.
3. A prestressing anchor as defined in claims 1 or 2 further comprising a central chamber in common connection with both co-operative pairs, and wherein internal surfaces of the body defining said chamber, inlet and outlet means provide a smooth path for prestressing tendons passing therethrough.
4. A prestressing anchor as defined in claim 3 wherein tendons passing through respective co-operative pairs may extend through said chamber closely interwoven.
5. A prestressing anchor as defined in any one of the preceding claims further comprising a filling aperture providing access to the body interior for filling the interior with mortar or like material.
6. A prestressing anchor as defined in any one of the preceding claims further comprising external rigid body structures which in use embed within surrounding concrete or like material so as to hold the anchor rigidly therein.

7. A structure comprising:

an anchor as defined in any one of the preceding claims rigidly embedded within the structure;

at least one tendon extending from a first tendon end at a point in the structure external of the anchor, entering a said inlet means in a direction substantially longitudinal of the anchor, extending through the anchor, exiting from the co-operative outlet means and extending to a second tendon end external of the anchor; and

prestressing grip means applied to said tendon at or intermediate said second tendon end and said outlet means to maintain the tendon in tension.

8. A structure as defined in claim 7 being of concrete and wherein said anchor is filled with concrete or like material.

9. A structure as defined in claim 7 or 8 wherein a respective set of tendons passes through each respective co-operative pair, the two sets of tendons crossing one another internally of the anchor in an interwoven array where each tendon exerts substantially no force on any adjacent tendon.

10. A method of anchoring and maintaining prestressing tendons in position for prestressing a concrete article or structure, comprising extending one or more elongate tendons from an end of said structure to an anchor located or positioned distal said end of said structure; said anchor comprising a body portion formed with both inlet and outlet means at opposing ends thereof; said inlet means on opposing ends being on substantially the same side of said anchor and each inlet means communicating with a substantially diagonally opposing outlet means; said outlet means each being on the same general side of said anchor; and passing said one or more tendons from

said end of said structure through inlet means at a first end of said anchor; through said body portion and out through substantially diagonally opposed outlet means; and thereafter pouring concrete about said tendons and anchor but with said outlet means and ends of said tendons extending therefrom remaining exposed, such as to allow said tendons to be stressed.

11. A method as defined in claim 10 wherein said anchor is positioned intermediate said end and a second opposite end of the structure and further including the steps of extending further tendons from said second end to pass through and out of said anchor and to tension said tendons.

12. A method as defined in claim 10 wherein the anchor is positioned at a second end of the structure, and left hollow so as to facilitate later coupling of a similar structure.

13. A method of coupling a new structure to an existing structure which includes exposed an anchor as defined in any one of the claims 1 to 6 positioned at an end of the existing structure to anchor ends of existing tendons within said existing structure, the method comprising the steps of passing new tendons anchored at an end of said new structure through said anchor and tensioning said new tendons.

14. A prestressing anchor being substantially as described herein with reference to the drawings.

15. A method of anchoring and maintaining prestressing tendons substantially as described herein with reference to the drawings.

16. A concrete, mortar, or like material structure or article being substantially as described herein with reference to the drawings.